Remarks

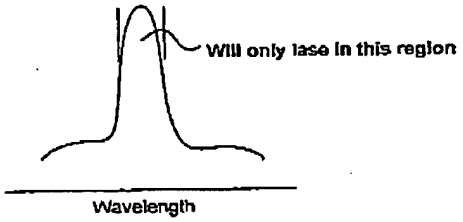
Claim 1 has been amended to specify that the laser diode has an active region that generates the laser light, and that it is this active region that contains the quantum dots (or wires). Support for this amendment is found, for example, page 9, line 3. Also, while the tunable laser is capable of emitting light over hundreds of nanometers (see page 2, line 15), it can be still useful over 100 nm (see page 15, line 10 for support).

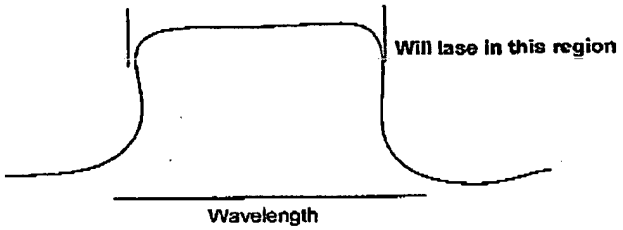
It is noted that the Examiner considers the applicant's previous submission moot in view of the newly cited art. In particular, the Examiner has replaced the Osinki reference, which the applicants showed lacked proper motivation to combine with Cook, with Petroff.

It is not disputed that Cook discloses one example of a tunable external cavity laser, although Cook is specifically directed to the novel anti-reflection coating rather than the structure of the laser. Cook uses a laser diode 10 as the laser medium.

The fundamental issue, where there is major disagreement with the Examiner, is whether it is *prima facie* obvious to use self-assembled quantum dots as the lasing medium in an external cavity tunable laser of the type shown, for example, in Cook. The applicants emphatically submit that it is not.

As has been explained to the Examiner in previous submissions, the present invention is based on the important realization that advantage can be taken of the inhomogeneous broadening that occurs during self-assembled quantum dots (or wires) to provide a lasing medium suitable for use in an external cavity tunable laser. A tunable laser needs a lasing medium that has a broad gain over the entire tunable spectrum of the laser. A lasing medium with a sharp gain spectrum (narrow peak) is clearly not suitable for a tunable laser since the laser can only operate at wavelengths within the sharp peak. No-one previously has recognized that this property of inhomogeneous broadening can be used to advantage in a tunable laser, and in reality this realization represents a very important advance in the art of tunable lasers. The broad gain spectrum means that the lasing medium will work over a wide range of wavelengths.





This concept is shown in a highly schematic fashion in the above figures. In the lower figure, which has a broad gain spectrum, lasing can take place over a much wider range of wavelengths, and therefore the lasing medium is useful for a tunable laser where it is desired to change the operating wavelength of the laser. This represents a very important advance in the art because it is very desirable to have a laser that will operate over a wide range of wavelengths. For example, Figure 3 of Cook only contemplates a maximum wavelength range of about 150 nm (due to the properties of his novel reflective coating), and he does not even state that his proposed lasing medium would achieve this range. The invention permits the wavelength to be tuned over hundreds of nanometers.

While in the absolute sense the invention (that the property of inhomogeneous broadening of self-assembled quantum dots can be used to advantage in a tunable laser) is clearly not obvious (none of the prior art remotely suggests the use of quantum dots as a lasing medium in a tunable laser and that important advantages can be gained thereby), the applicants recognize that they nevertheless also have to overcome the artificial hurdle of showing that it is not obvious to combine the references for reasons unrelated to the invention, or else show that the art the Examiner is combining is non-analogous.

The Examiner will appreciate that quantum dots, by their quantum nature, emit sharp spectra, which while potentially useful for a laser of fixed wavelength, *prima facie* would

be the antithesis of what is required for a tunable laser. Sugiyama states at col. 1, line 34 that quantum dots produces a "very sharp spectrum when used in a semiconductor device". Without appreciating the invention (which takes advantage of inhomogeneous broadening during self-assembled growth), there would be a strong disincentive to use quantum dots in a tunable laser. It is *prima facie* not obvious therefore to use quantum dots in a tunable laser, where the gain spectrum must be broad, not sharp. The Examiner must take into account the suggestive power of all the references (see MPEP 2143.01), and clearly since the teaching of Sugiyama is that quantum dots have a sharp spectrum, which is contrary to what is required for a tunable laser, and Petroff is silent in this regard, especially as it has nothing to do with lasers, the teaching of Sugiyama away from the proposed combination should prevail.

In order to establish a *prima facie* case of obviousness under 35 USC 103(a),

> "there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success." See MPEP 2143. (emphasis added)

The Examiner has combined Cook with Petroff. The alleged motivation offered by the Examiner is to provide a reliable semiconductor lasing device.

Petroff describes a far infrared detector using self-assembled quantum dots to upconvert the far infrared to more easily detectable near infrared. An incident photon at a first wavelength excites an electron in a quantum dot. The excited electron then tunnels through a barrier into a stress induced quantum dot, and therein produces a photon at a second wavelength. What his this got to do with a lasing medium?

The applicants have great difficulty understanding the Examiner's position since Petroff does not even disclose a laser. Petroff is not even related to a lasing medium. What possible motivation could there be to put a far infrared detector, or even a wavelength upconverter in an external tunable cavity laser as the lasing medium??? The laser would not work because the upconverting medium as described in Petroff does not have a population inversion and therefore would not give rise to the stimulated emission required

to make a tunable laser operate. It cannot be obvious to do something that would not work.

The CCPA has declared that references should only be considered if they are

> "reasonably pertinent to the particular problem with which the inventor was involved." *In re Wood*, 202 USPQ 171 (emphasis added)

The Federal circuit qualified what was meant by "reasonably pertinent" in *In re Clay*, 23 USPQ 2d 1058:

> A reference is reasonably pertinent if...it is one which, because of the matter with which it deals, logically would have commended itself to the inventor's attention in considering his problem...If a reference disclosure has the same purpose as the claimed invention, the reference relates to the same problem...[If it is directed to a different purpose, the inventor would accordingly have had less motivation of occasion to consider it". (emphasis added)

Petroff has nothing whatsoever to do with the applicant's problem, which is the provision of a laser tunable over a wide range, which in turn requires a broad gain lasing medium in a tunable laser. In fact Petroff has so little to do with the invention, or even lasers in general, the applicants wonder whether the Examiner has cited the correct reference. Petroff teaches how to a far infrared detector employing an upcoverter using quantum dots, but since this invention has no relation whatsoever to tunable lasers, where no upconversion takes place, Petroff must be considered non-analogous in view of the case law. There is no reason to suppose that a person seeking to improve tunable lasers would find Petroff of any value since it does not even relate to lasers of any kind, never mind tunable lasers.

It is well established law that the motivation to combine must be found in the prior art, not in the applicant's teachings.

> "Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the

references themselves or in the knowledge available to one of ordinary skill in the art. (See MPEP 2143.01)

As stated in *Lindemann Maschinenfabrik GmbH v. America Hoist & Derrick* Co., 221 USPQ 488, in considering obviousness:

"The critical enquiry is whether "there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination." (emphasis added)

Since Petroff does not suggest that the use of quantum dots or quantum wires produce a lasing medium, never mind a reliable lasing medium, it is not understood on what basis the Examiner asserts that one skilled in the art would be motivated to use the quantum dots of Petroff, which are not disclosed as a lasing medium, and certainly not a broad gain lasing medium, in a tunable laser where they could not fulfill their function as an upconverter.

"THE PROPOSED MODIFICATION CANNOT CHANGE THE PRINCIPLE OF OPERATION OF A REFERENCE". (See bold heading MPEP 2443.01).

"If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the reference are not sufficient to render the claims prima facie obvious". *In re Ratti*, 123 USP 340.

Petroff would have to be modified from an upconverter to a lasing medium, which is a totally different principle of operation (and it is not even clear how this could be done). For this reason also, Petroff is insufficient.

The case law that says that the Examiner's motivation can be different from the applicants' deals with a very specific situation where, for example, the choice of materials is trivial, and the applicants purport to have found an additional advantage associated with a material that is otherwise well know for the particular application. It was never intended to permit Examiners to destroy important inventions based on an effect that had hitherto been seen as a problem, not an advantage, by making an artificial hindsight combination. In reviewing the CAFC decisions, the court always looks to the problem addressed by the

inventor (in this case tunable laser). It does not look kindly on arguments based on a combination of prior art that has nothing whatsoever to do with the problem at hand.

Unfortunately, Examiners, aware of the need to show motivation, often merely identify some generic advantage as the motivation. In this case, it is impossible to see how Petroff can justify the alleged motivation of "providing a reliable semiconductor device" since Petroff is not concerned with reliability, and as noted above is not even concerned with a lasing medium.

In *In re Fitch*, 23 USPQ 2d 1780, the Federal Circuit held that:

> "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification..."
>
> "Here the Examiner relied on hindsight to arrive at the determination of obviousness. It is impressible to use the claimed invention as an instruction manual or "template" to piece together the teachings of the prior art."

Having regard to the fact that the Examiner's rejections of the remaining claims all involve Petroff, which as noted does not even relate to lasers, it is respectfully submitted that the remaining rejections are all fatally flawed for essentially the same reasons as noted above.

If the Examiner wishes to maintain his objections, the applicants respectfully request an interview.

In summary, Petroff has absolutely nothing to do with lasing media, or lasers of any kind, and cannot therefore render claim 1 obvious since a combination of Petroff's far infrared to near infrared upconverter with Cook's external cavity laser, which the applicants respectfully and emphatically submit is improper for the reasons noted above, does not result in the present invention. In the absence of any teaching in Petroff as to the use of quantum dots as a lasing medium for use in any kind of laser, it is not understood how the Examiner can seriously propose a combination of these two references as a basis for a prima facie obviousness argument.

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Art Unit 2815

It is believed that this application is in condition for allowance and reconsideration and allowance are respectfully requested.

Respectfully submitted

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